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ORIGINAL ARTICLE

Treatment of acute scapholunate ligament injuries with bone anchor

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Abstract Scapholunate instability is the most common form of carpal instability. Repair or reconstruction of the scapholunate interosseus ligament is advocated to reduce symptoms, stabilize the scapholunate joint and avoid the progression of carpal degeneration. Aim of this study is to evaluate the results (clinical and radiographic) obtained in 18 patients treated in our department for acute lesions SLIL from 2003 to 2008. Patients were 16 males and 2 females with an average age at the time of the trauma of 33.8 years old (min 17 and max 68 years). The diagnosis of scapholunate dissociation relies on a through history and physical examination and imaging studies. Early surgical repair of the torn schapolunate ligament was performed in all the patients. The method used for the treatment of these lesions was open reduction and direct ligament reinsertion through a minianchor MITEK®. In our surgical experience in 3 cases we have found a combination between an isolated scaphoid fractures and a scapholunate ligament rupture without carpal dislocation. We reviewed all patients treated with an average follow-up of 32 months (range 9–68 months). The review was carried out both clinically and radiographically (static and dynamic). We achieved 13 excellent results (Mayo score average 94,77), 3 good results (Mayo score average 84), 1 sufficient results (Wrist score 72) and 1 bad result (Wrist score 35). From the radiographic evaluation we found a loss of reduction in the two cases identified clinically as sufficient and bad. One patient after an optimal ligament healing, underwent to a recurrence of the lesion SLIL 2 years from surgery. Open reduction and direct bony fixation of the torn scapholunate ligament using a suture anchor is generally successfull in restoring scapholunate stability and has produced good functional mid-term results. At an average follow up of 32 months excellent or good functional outcomes were reported in 88% of the patients despite a large number of cases with a high energy trauma and other associated injury. The association between an isolated scaphoid fracture and a SLIL lesion is rare but not impossible in presence of a scapholunate instability we recommend the immediate reconstruction of the torn ligament.

Keywords Wrist · Hand · Scapholunate instability · Scapholunate ligament · Scaphoid · Lunate · Anchor

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Introduction

Wrist ligament injuries are forms of traumatic instability, insidious and complex, that often involve young people and that are due to sport injuries, work injuries or road accidents. These lesions could be isolated, in patients that had a single trauma to the wrist (sport or work injuries), or in association to other lesions in politraumatized patients (road accidents).

In acute the diagnosis of these lesions is often difficult because the standard radiographic examination cloud not show any carpal abnomality [1].

Scapholunate instability is the most common form of carpal instability. Repair or reconstruction of the scapholunate interosseus ligament is advocated to reduce symptoms, stabilize the scapholunate joint and avoid the progression of carpal degeneration.

The elapsed time between injury and diagnosis is crucial to choice the type of treatment to perform, this is tightly contingent to the biomechanics efficiency of the ligament that progressively decreases with time; when the central component is interrupted the intrinsic ligaments degenerate very quickly (even in less than 2 weeks) [2, 3]. A correct reinsertion and healing of the ligament is possible only in the acute lesions within 4 weeks from the trauma [4].

Aim of this study is to evaluate the results (clinical and radiographic) obtained in the patients treated in our department for acute lesions of the scapholunate ligament.

Materials and methods

At the 1st Orthopaedic Department of the University of Pisa from 2003 to 2008 18 cases of acute lesion of the scapho-lunate ligament (SLIL) have been treated.

Patients were 16 males and 2 females with an average age at the time of the trauma of 33.8 years old (min 17 and max 68 years).

In 8 cases the lesion of the SLIL was due to medium–high energy trauma (traffic road accident/sport injury) and was associated to other lesions such as scaphoid fracture (3 cases), fractures of the metacarpal bones (1 case), perilunate dislocations of the carpus (2 cases), trans-scapho perilunate fracture-dislocation, fracture-dislocation of the schapoid proximal pole (1 case), lesion of the ulno-pyramidal ligament (1 case) and neuro-vascular injuries (1 case).

In 10 cases the lesion of the SLIL was isolated, in 6 cases it was due to a sport injury (practicing snowboarding and football), in 3 cases to a work related accident and in 1 case to an accidental fall down.

In acute the diagnosis of SLIL could be difficult because in high energy trauma the patient are often politrumatized with other major skeletal injuries while in low energy trauma the symptoms are mild and the standard radiographic examination is often negative.

The diagnosis of scapholunate dissociation relies on history, physical examination and imaging studies (Table 1). Early diagnosis offers the best chance for successful surgical outcome. Despite this, scapholunate injury is often not diagnosed until later stages of disease when plain radiographs show clear evidence of abnormality [5, 6].

Physical examination will often found mild swelling in the scapholunate region. The scapho-lunate interval is located by placing the wrist into flexion and palpating the dorsal aspect of the wrist just distal to Lister's tubercle. Additionally, a provocative maneuver, such as Watson's scaphoid shift test, will often increase pain and produce a clunk or snap [7]. A painful snap is obtained when pressing hard on the scaphoid tubercle volarly and moving the wrist from ulnar to radial deviation, the wrist being maintained in axial compression.

The clinical suspect of a scapholunate instability must be always confirmed by an accurate, static and dynamic, radiographic evaluation.

Radiographic static examination should include at least two views: an anteroposterior projection and a lateral view to show the presence of a dissociative carpal instability (CID). On AP plain films of the wrist, the radiographic sign of a scapholunate instability are the distruption of the Gilula's Lines, the presence of a gap between scaphoid and lunate "Terry-Thomas sign" (a scapholunate interval of >2 mm is suspicious and >4 mm is virtually diagnostic for scapholunate instability) [8] and the schapoid ring sign. The lateral radiograph in patients who have scapholunate instability may show rotatory subluxation of the scaphoid; the scaphoid will be abnormally flexed and the lunate may be abnormally extended. This positioning leads to an increase in the scapholunate angle as viewed on the lateral radiograph.

An additional dynamic radiographic evalutation by video fluoroscopy may show a dynamic instability (non dissociative carpal instability CIND) not apprecated on the static anteroposterior and later radiographs [9]. The fluoroscopic evalutation may show an abnormal movement between the scaphoid and lunate (typically a fluidity of motion occurs between the scaphoid and lunate as the wrist is moved from ulnar to radial deviation). In our experience the fluoroscopic evaluatiuon must be always done when there is a high clinical suspect of a scapholunate ligament lesion and the static radiographic evaluation do not show any sign of abnomality.

Plain films and fluoroscopic evaluation will sometimes fail to see the early signs of scapholunate instability when the ligaments are torn but the scaphoid has yet to sublux. In these situations when the clinical suspicion is high, or when plain films have already detected the dislocation and further evaluation is needed to plan surgical treatment, an arthro-MRI could complete the diagnosis showing directly the torn scapholunate ligament [10]. At our institution we make a high resolution MRI Arthrography that must be read by trained musculoskeletal magnetic resonance radiologists. The leakage of the constrast material, introduced into the midcarpal joint, trought the scapholunate interosseous ligament into the radiocapal joint is indicative of a ligament lesion [5, 6, 10].

Early surgical repair of the torn schapolunate ligament was performed in all the patients. The method used for the treatment of these lesions was open reduction of the scaphoid and the lunate, through a dorsal access, and direct scapho-lunate ligament reinsertion through a minianchor MITEK® preloaded with a not absorbable suture; at the ligament reinsertion was always associated the scaphoid

Table 1 Patients details and results of diagnostic tools (clinical evaluation, radiographical study and Arthro MRI study)

	Sex	Age	Time elapsed before treatment	Mechanism of injury	Associated injury	Wrist pain	Watson's test	Rx evaluation (static)	Fluoroscopic evaluation	Arthro-MRI	Type of instability
1	M	52	14 days	Road accident	–	High	Positive	Positive	–	–	CID
2	M	23	4 days	Road accident	Scaphoid Fracture dislocation	High	–	Positive	–	–	CID
3	F	19	2 days	Sport	–	High	Positive	Negative	Positive	Positive	CIND
4	M	34	14 days	Accidental fall down	Scaphoid Fracture	High	–	Negative	Positive (Intraoperative)	–	CIND
5	M	25	14 days	Sport	–	Mild	Positive	Negative	Positive	Postive	CIND
6	M	31	14 days	Sport	Ulno-pyramidal ligament rupture	High	Positive	Positive	–	Positive	CID
7	M	27	21 days	Road accident	Open Perilunate Dislocation	High	–	Positive	–	–	CID
8	M	68	10 days	Road accident	Firtst metacarpal bone Fracture	High	–	Positive	–	–	CID
9	M	26	6 days	Road accident	Scaphoid Fracture	High	–	Negative	Positive (Intraoperative)	–	CIND
10	M	42	12 days	Work	–	Mild		Negative	Negative	Positive	CIND
11	M	31	8 days	Sport	–	High	Positive	Negative	Positive	Positive	CIND
12	M	24	4 days	Sport	Perilunate Dislocation	High	–	Positive	–	–	CID
13	M	22	10 days	Sport	–	Mild	Positive	Negative	Positive	Positive	CIND
14	M	48	16 days	Work	–	Mild	Positive	Negative	Positive	Positive	CIND
15	M	36	20 days	Road accident	Trans-scapho Perilunate Dislocation	High	–	Positive	–	–	CID
16	M	40	11 days	Work	–	High	Positive	Positive	–	–	CID
17	M	45	5 days	Road accident	Scaphoid Fracture	High	–	Negative	Positive (Intraoperative)	–	CIND
18	F	17	4 days	Sport	–	Mild	Positive	Negative	Positive	Positive	CIND

and lunate stabilization with Kirschner's wires how described by O'Brian [11]. The dorsal approach is performed through an incision between the third and fourth extensor channel, diverging the tendon of the extensor pollicis longus and the tendon of the common extensor of the fingers [12]. The carpal bones are displayed making a dorsal longitudinal capsulotomy along the third finger of the hand. Then the scaphoid and the lunate are identified and between these two bones the stumps of the scapholunate ligament; the ligament could be torn in the middle part or, more frequently, detached from lunate or from scaphoid. An accurate reduction of the articular surface between scaphoid and lunate is required, it could be obtained passing 2 Kirschners wires into the dorsum of the lunate and schapoid that are used as joy-sticks to reduce any rotatory subluxation [13]. It is often useful to have an assistant who tractions the hand from the third finger to leave off the capitate from the schapolunate interval; in some cases the capitate comes backwards towards the radio and prevents, interposing even partially in the carpus proximal row, a proper comparison between the scaphoid and the lunate.

The reduction of the scapholunate distasis should be carefully examined and confirmed with fluoroscopy and maintained with two percutaneus Kirschner wires: one passed across the scapholunate joint and one across the scaphocapitate joint.

Scapho-lunate ligament reconstruction is made using a mini-anchor (we usually use the MITEK® minianchor armed with two needles with a non-absorbable suture) placed at the ligament avulsion point (on schapoid or lunate) [14]; the torn ligament is basted by arranging the fibers according to their physiological course and then it is reattached to the bone.

The wrist is immobilized in a long arm cast; the Kirschner wires and the cast are retained for 4 weeks; after that the Kirschner wires are removed and the wrist is immobilized with a short arm cast or brace for an other 3–4 weeks, during

this period the patient begins a gentle and progressive active and passive range of motion exercises avoiding lifting weights and heavy manual tasks.

In our surgical experience in 3 cases we have found a combination between an isolated scaphoid fractures and a scapholunate ligament rupture without carpal dislocation. After the syntesis of the scaphoid fracture we always make an accurate fluoroscopic evaluation of the scapho-lunate ligament; a scapho-lunate instability could be identified through a manual traction along the first ray or through provocative test. In presence of a dynamic scapholunate dissociation (CIND) at the scaphiod fixation is always associated the reattachment of the torn ligament through a dorsal access (Fig. 1).

We reviewed all patients treated with an average follow-up of 32 months (range 9–68 months). The review was carried out both clinically and radiographically (static and dynamic).

The clinical evaluation was based on the Mayo Wrist score (see Table): a score between 90 and 100 identifies a very good result, between 80 and 89 a good result, between 65 and 79 a sufficient result and a score under 65 points a bad result.

The radiographic evaluation was based on standard radiographs in AP and LL and on a dynamic evaluation

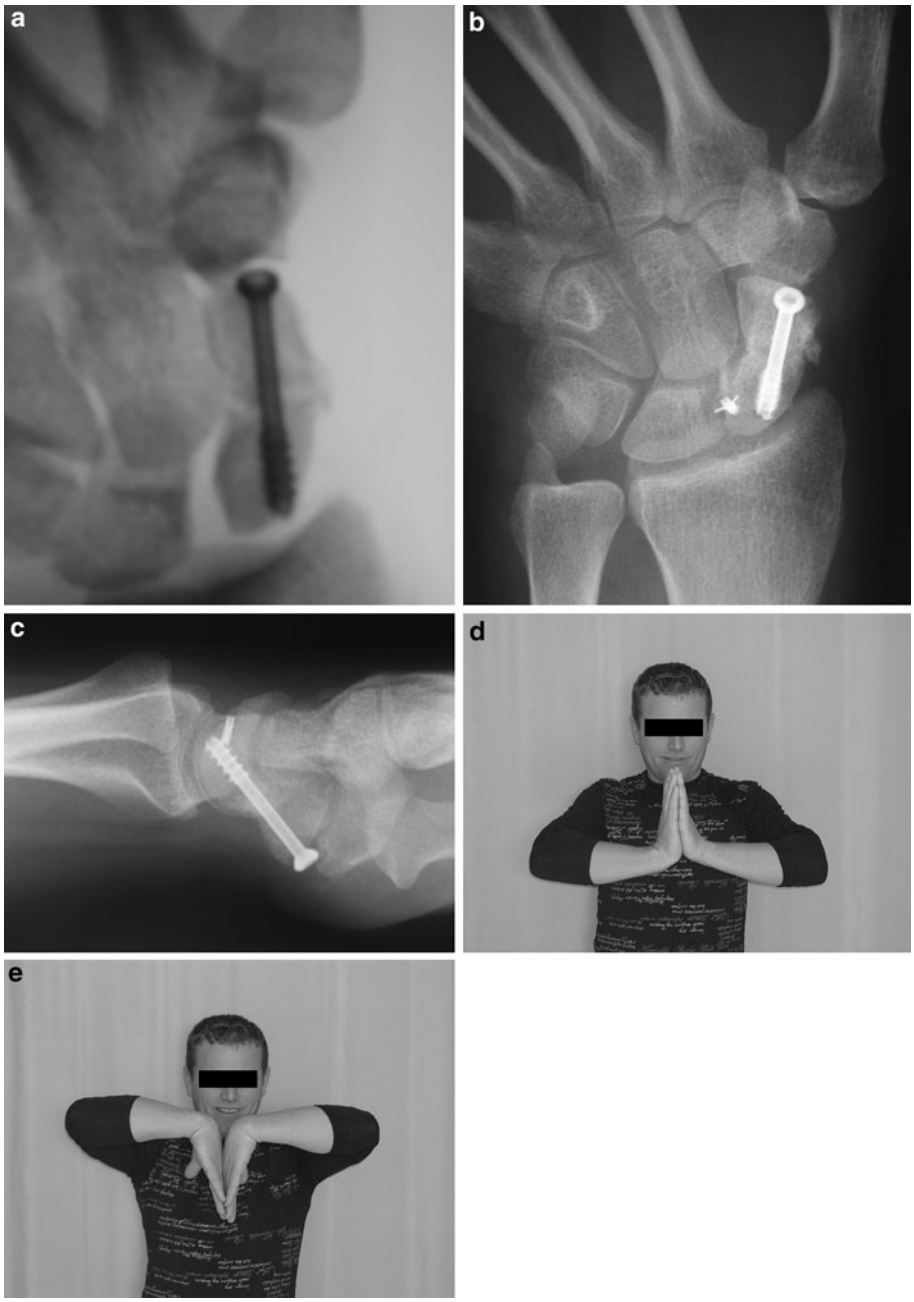

Fig. 1 A 34-year-old man with an isolated scaphoid fracture due an accidental fall down. **a** The scaphoid fracture was treated with a percutaneous cannulated titanium screw ASNIS III®. The intraoperative fluoroscopic evaluation of the scapho-lunate ligament showed the presence of a dynamic scapho-lunate instability under stress maneuvers (CIND). **b**, **c** The scapho-lunate ligament was repaired trought a dorsal access using a mini-anchor MITEK®. The radiographic evaluation at 21 months shows the scaphoid fracture healing and no signs of scapholunate instability. **d**, **e** The clinical evaluationat 21 months shows a wrist full functional recovery (Mayo wrist score 94)

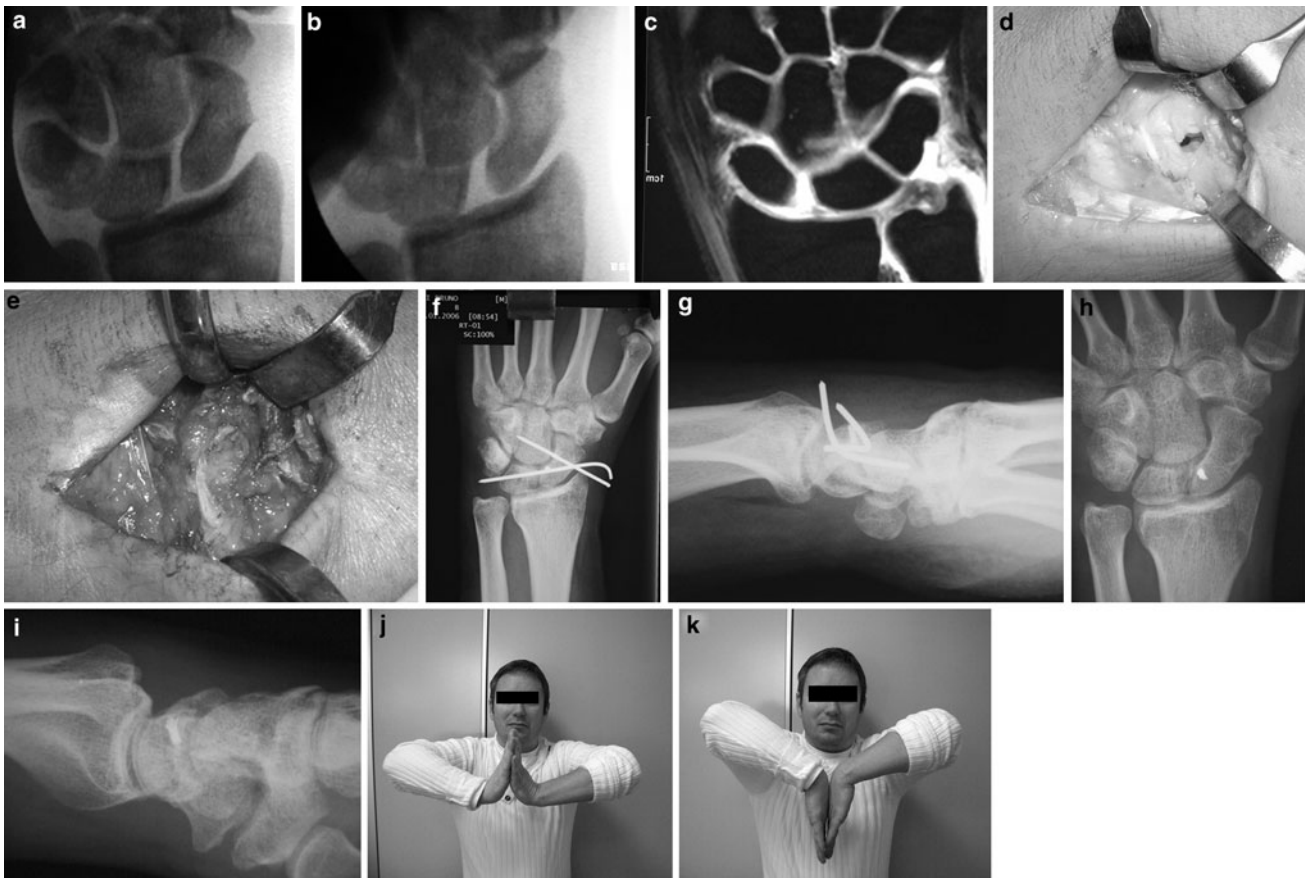

Fig. 2 A 31-year-old man sustained a closed wrist injury due to a sport accident. **a**, **b** The fluoroscopic evaluation of the wrist showed the presence of a dynamic scapho-lunate instability under stress maneuvers (CIND). **c** The diagnosis was confirmed with an arthro-MRI that shows the contrast leakage in the midcarpal joint. **d**, **e** An open reduction of scaphoid and lunate was performed through a dorsal access. The torn scapholunate ligament was reinserted on the scaphoid through a minianchor MITEK®. **f**, **g** Post-surgical radiographs. The reduction of the scapholunate distasis should be carefully examined and confirmed with fluoroscopy and maintained with two percutaneus Kirschner wires: one passed across the scapholunate joint and one across the scaphocapitate joint. **h**, **i** At 19 months of follow-up the radiographic evaluation shows no signs of scapholunate instability. **j**, **k** The clinical evaluation shows a good functional recovery (Mayo wrist score 95)

with a fluoroscopy through functional tests. We sought signs of static or dynamic scapholunate dissociation as the presence of an abnormal diastasis between the two bones and a scaphoid abnormal flexion.

Results

The results obtained from the review of our case series of SLIL acute lesions were very encouraging, especially if we take into account the serious deterioration of the wrist kinematics caused by these injuries and the possible evolution in a degenerative arthrosis of the wrist (SLAC syndrome) which it can lead (Table 2).

We achieved 13 excellent results (Mayo score average 94,77) with great patient's satisfaction (no pain and no functional limitations), no radiographic alterations of the wrist and good stability of the scapho-lunate ligament under fluoroscopic control.

We achieved 3 good results (Mayo score average 84) with occasional pain in conditions of maximum demand and a mild functional limitation of the wrist flexion (10°–20°); the radiographic evaluation (static and dynamic) did not show any signs of instability (Fig. 2).

We achieved 1 sufficient results (Wrist score 72). This patient had occasional pain under stress and during weather conditions changes, a limitation of the ROM of the wrist, with limitations in palmar (20°) and dorsal flexion (30°) and a significant strength reduction.

We achieved 1 bad result (Wrist score 35) with pain even for simple manual activities associated with a severe functional limitation, despite an almost complete recovery of the wrist articular excursion. This result is partially due to the serious injuries associated with the scapho-lunate

lesion (exposed perilunate dislocation of the wrist with lesion of the ulnar nerve and of the ulnar artery and elbow dislocation).

From the radiographic evaluation we found a loss of reduction in the two cases identified clinically as sufficient and bad.

One patient after an optimal ligament healing, underwent to a recurrence of the SLIL lesion 2 years from surgery. This patient is now undergoing to a new surgical reconstruction of the SLIL using a dorsal capsulodesis. This patient is still in treatment today.

Discussion

Numerous surgical procedures have been devised to address posttraumatic scapholunate dissociation, with the goals being improvement of wrist pain and function and potential prevention or delay of carpal arthritis.

In the past the attitude was to repair only the volar component of the scapho-lunate ligament or to repair both components through a double surgical access volar and dorsal [13]. Biomechanical studies have shown that to obtain a carpal kinematics as close as possible to normal,

Table 2 Patiens details and results of clinical and radiographical evaluation

	Sex	Age	Time Elapsed before treatment	Mechanism of injury	Associated injury	Mayo score	Rx evaluation		ROM	Result
							Scapholunate diastasis	Scapholunate angle		
1	M	52	14 days	Road accident	–	92	None	47°	No limitatios	Excellent
2	M	23	4 days	Road accident	Fracture dislocation schapoid	82	None	54°	Limitation of wrist flexion (20 degrees) and wrist extension (25 degrees)	Good (pain in conditions of maximum demand)
3	F	19	2 days	Sport	–	97	None	44°	No limitatios	Excellent
4	M	34	14 days	Accidental fall down	Scaphoid Fracture	94	None	47°	No limitatios	Excellent
5	M	25	14 days	Sport	–	98	None	45°	No limitatios	Excellent
6	M	31	14 days	Sport	Ulno-pyramidal ligament rupture	93	None	48°	No limitatios	Excellent
7	M	27	21 days	Road accident	Open Perilunate Dislocation	35	3 mm	62°	Loss 30° of flexion	Bad (severe functional limitation)
8	M	68	10 days	Road accident	Fr I metacarpal bone	92	None	52°	No limitatios	Excellent
9	M	26	6 days	Road accident	Scaphoid Fracture	94	None	43°	No limitatios	Excellent
10	M	42	12 days	Work	–	86	None	42°	Limitation of wrist flexion (10 degrees)	Good (pain in conditions of maximum demand)
11	M	31	8 days	Sport	–	95	None	50°	No limitatios	Excellent
12	M	24	4 days	Sport	Perilunate Dislocation	84	None	44°	Limitation of wrist flexion (20 degrees)	Good (pain in conditions of maximum demand)
13	M	22	10 days	Sport	–	98	None	45°	No limitatios	Excellent
14	M	48	16 days	Work	–	94	None	47°	No limitatios	Excellent
15	M	36	20 days	Road accident	Trans-scapho Perilunate Dislocation	72	3 mm	57°	Limitation of wrist flexion (30 degrees) and wrist extension (20 degrees)	Sufficient (occasional pain under stress and during weather conditions changes)
16	M	40	11 days	Work	–	95	None	49°	No limitatios	Excellent
17	M	45	5 days	Road accident	Scaphoid Fracture	92	None	40°	No limitatios	Excellent
18	F	17	4 days	Sport	–	98	None	45°	No limitatios	Excellent

we need to repair only the dorsal component of the ligament [15].

As suggested by Taleisnik [16] repair of the SLIL is performed through a dorsal access, this allows a proper exposure of the surgical field and allows an easy bone reinsertion of the ligament. The use of bone anchors to restore rotational stability of the SL joint has been described before [17, 18]. Packer et al. reported a case of direct scapholunate ligament suture which was augmented by an additional suture between two bone anchors in the scaphoid and lunate, respectively [19].

A review of this technique (open reduction and direct ligament reconstruction) performed by Minami and Kaneda has shown that it provides a significant reduction of the post-traumatic scapholunate instability and permits the maintenance of a good range of motion [20]. Bickert el al. have reported good functional and radiographic results in a series patient with acute scapholunate ligament lesion treated with the Mitek bone anchor [21]. Pliný et al. reported a high rate (94%) of excellent and good functional results in a series of 17 patients with acute SLIL lesion treated with the Mitek bone anchor at 2 years of follow up [22].

Most failures of this technique are mainly due to the force that the capitato makes on the scapholunate interval that could cause the rupture of the repaired ligament [23] as it probably happened in the case of the recurrent scapholunate lesion at 2 years from the surgical repair that we have previously described.

In conclusion, direct bony fixation of the torn scapholunate ligament using a suture anchor is generally successfull in restoring scapholunate stability and has produced good functional mid-term results. Open reduction, trough a dorsal access, allows an optimal visualization of the scaphoid and the lunate articular surface and allows a precise comparison of the two bones. The ligament reinsertion with the Mitek anchor allows an early mobilization if compared to the percutaneous stabilization with Kirschner wires, whether it is performed under fluoroscopic or arthroscopy control.

At an average follow up of 32 months excellent or good functional outcomes were reported in most of 88% of the patients despite a large number of cases (8/18) with a high energy trauma and other associated injury (carpal dislocatios, scaphoid fracture…) (Table 2). We believe that open reduction and direct ligament reinsertion represent the gold standard of treatment of the acute scapholunate instability.

Finally, we want to emphasize the possible association between an isolated schaphoid fracture and a schapolunate instability as we have found for several times during our surgical experience (Fig. 2). Scapholunate ligament injury is seldom reported in association with an acute scaphoid fracture [24, 25] but is more frequently described in association with a scaphoid fracture nonunion [26, 27]. Schadel-Hopfner reported thirteen traumatic tears of the scapholunate inter-osseous ligament in a series of 34 wrist arthroscopies made in patients with an acute scaphoid fracture; this equates to more than one-third of the arthroscopy cases, but only 7 per cent of the 189 isolated acute scaphoid fractures treated in the same time period [28]. The association between an isolated scaphoid fracture and a SLIL lesion is rare but not impossible, in presence of an isolated scaphoid fracture that needs a surgical treatment we always recommend an accurate fluoroscopic evaluation of the scapholunate ligament stability; in presence of a scapholunate instability we recommend the immediate reconstruction of the torn ligament how previus described.

Conflict of interest None.

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